



July 2005

**FRFET™**

# FQP11N50CF/FQPF11N50CF

## 500V N-Channel MOSFET

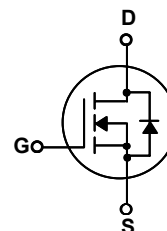
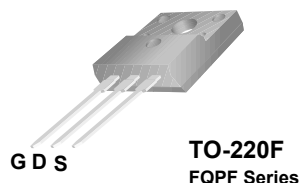
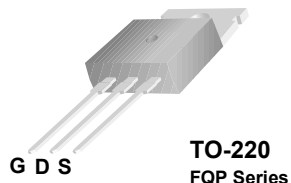
### Features

- 11A, 500V,  $R_{DS(on)} = 0.55\Omega$  @  $V_{GS} = 10V$
- Low Gate Charge (typical 43 nC)
- Low  $C_{rss}$  (typical 20pF)
- Fast Switching
- 100% Avalanche Tested
- Improved dv/dt Capability
- Fast Recovery Body Diode (typical 90ns)

### Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies, active power factor correction, electronic lamp ballasts based on half bridge topology.



### Absolute Maximum Ratings

Symbol	Parameter	FQP11N50CF	FQPF11N50CF	Units
$V_{DSS}$	Drain-Source Voltage	500		V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ )	11	11 *	A
	- Continuous ( $T_C = 100^\circ\text{C}$ )	7	7 *	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	44	44 *	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$		V
$E_{AS}$	Single Pulsed Avalanche Energy (Note 2)	670		mJ
$I_{AR}$	Avalanche Current (Note 1)	11		A
$E_{AR}$	Repetitive Avalanche Energy (Note 1)	19.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ )	195	48	W
	- Derate above $25^\circ\text{C}$	1.56	0.39	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150		$^\circ\text{C}$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300		$^\circ\text{C}$

\* Drain current limited by maximum junction temperature

### Thermal Characteristics

Symbol	Parameter	FQP11N50CF	FQPF11N50CF	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.64	2.58	$^\circ\text{C/W}$
$R_{\theta JS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	$^\circ\text{C/W}$

## Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FQP11N50CF	FQP11N50CF	TO-220	--	--	50
FQPF11N50CF	FQPF11N50CF	TO-220F	--	--	50

## Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	500	--	--	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C	--	0.5	--	V/°C
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 500 V, V <sub>GS</sub> = 0 V	--	--	10	μA
		V <sub>DS</sub> = 400 V, T <sub>C</sub> = 125°C	--	--	100	μA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 30 V, V <sub>DS</sub> = 0 V	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -30 V, V <sub>DS</sub> = 0 V	--	--	-100	nA
On Characteristics						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.0	--	4.0	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 5.5 A	--	0.48	0.55	Ω
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 40 V, I <sub>D</sub> = 5.5 A (Note 4)	--	15	--	S
Dynamic Characteristics						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz	--	1515	2055	pF
C <sub>oss</sub>	Output Capacitance		--	185	235	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		--	25	30	pF
Switching Characteristics						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 250 V, I <sub>D</sub> = 11 A, R <sub>G</sub> = 25 Ω (Note 4, 5)	--	24	57	ns
t <sub>r</sub>	Turn-On Rise Time		--	70	150	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	120	250	ns
t <sub>f</sub>	Turn-Off Fall Time		--	75	160	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 400 V, I <sub>D</sub> = 11A, V <sub>GS</sub> = 10 V (Note 4, 5)	--	43	55	nC
Q <sub>gs</sub>	Gate-Source Charge		--	8	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	19	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		--	--	11	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		--	--	44	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 11 A	--	--	1.4	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 11 A, dI <sub>F</sub> / dt = 100 A/μs (Note 4)	--	90	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	1.5	--	μC

### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 10\text{ mH}, I_{AS} = 11\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 11\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

## Typical Performance Characteristics

Figure 1. On-Region Characteristics

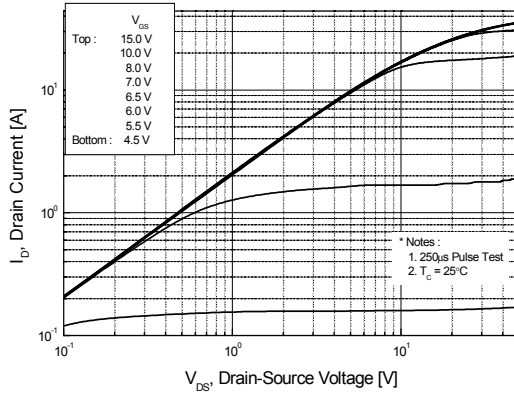


Figure 2. Transfer Characteristics

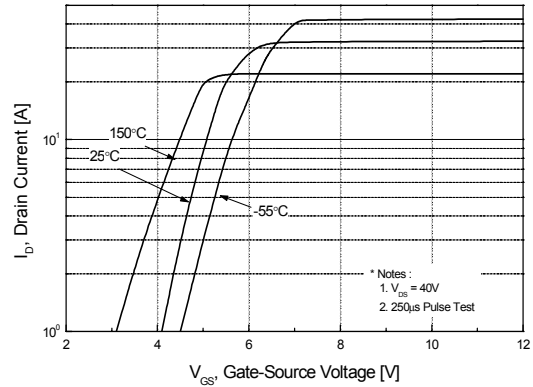


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

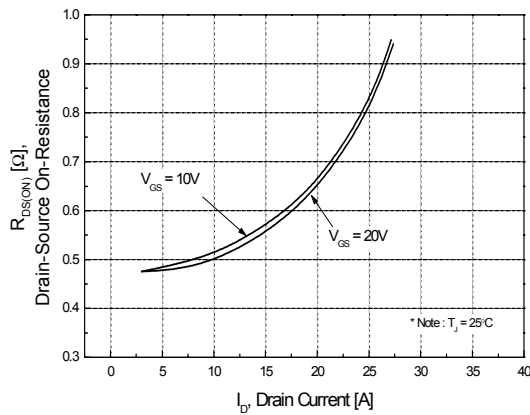


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

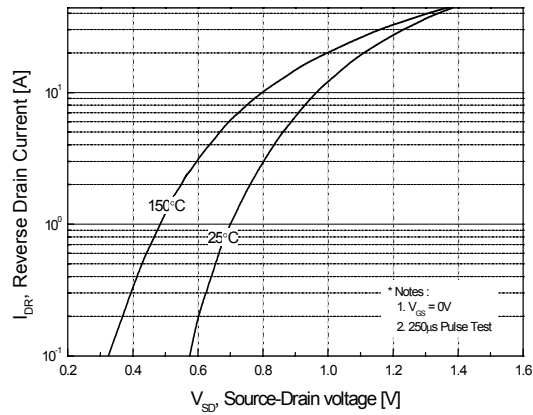


Figure 5. Capacitance Characteristics

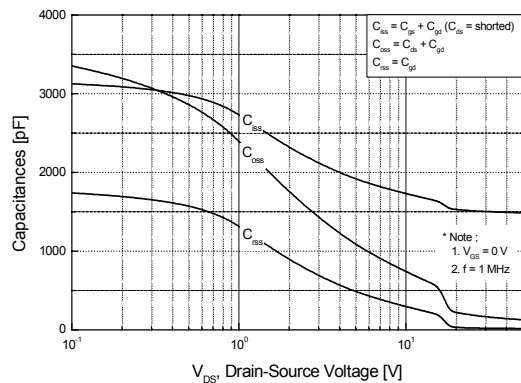
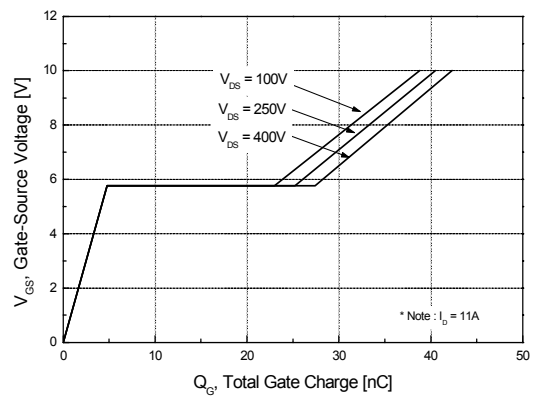
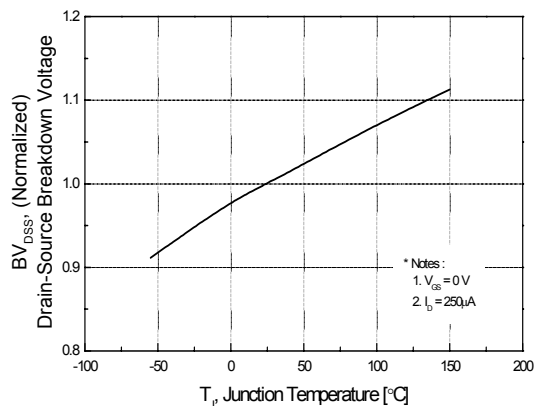


Figure 6. Gate Charge Characteristics

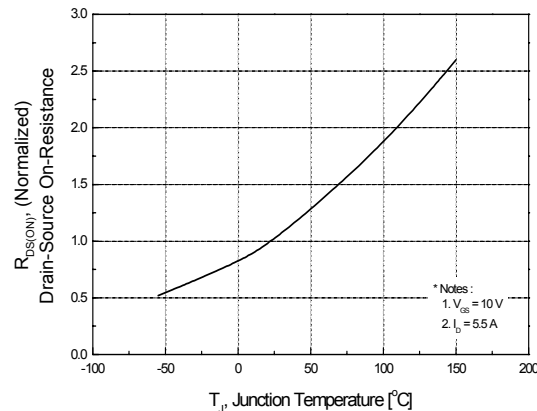


## Typical Performance Characteristics (Continued)

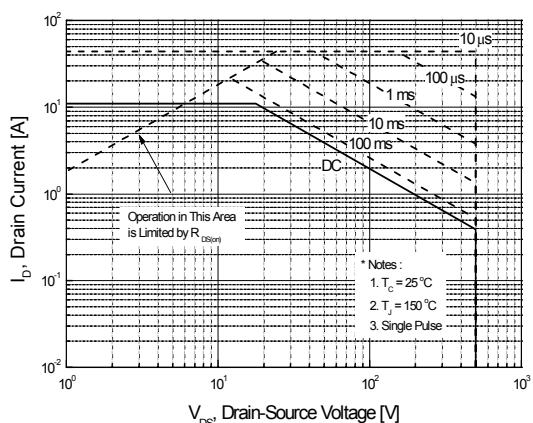
**Figure 7. Breakdown Voltage Variation vs. Temperature**



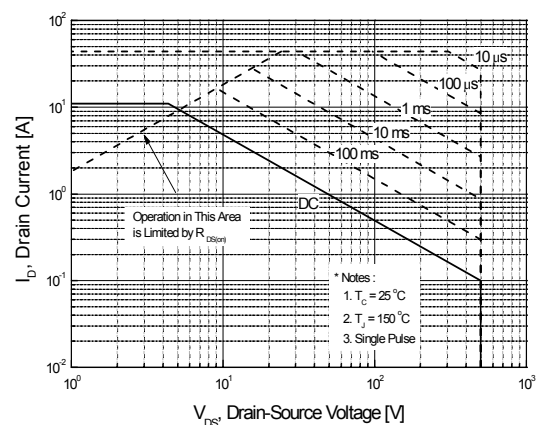
**Figure 8. On-Resistance Variation vs. Temperature**



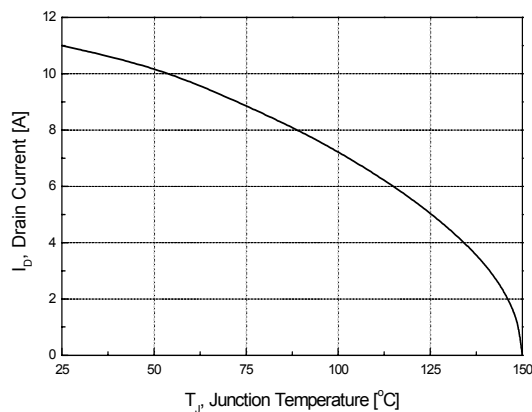
**Figure 9-1. Maximum Safe Operating Area for FQP11N50CF**



**Figure 9-2. Maximum Safe Operating Area for FQPF11N50CF**

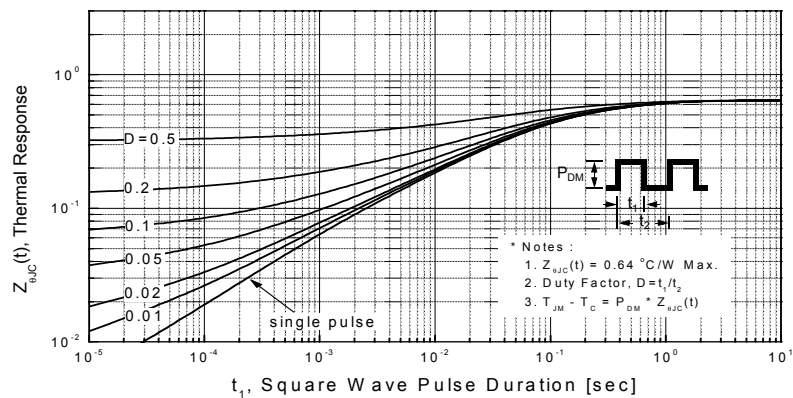


**Figure 10. Maximum Drain Current vs. Case Temperature**

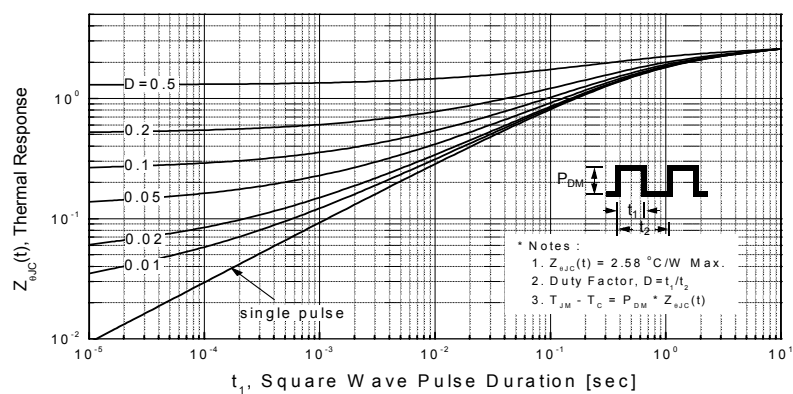


# Typical Performance Characteristics (Continued)

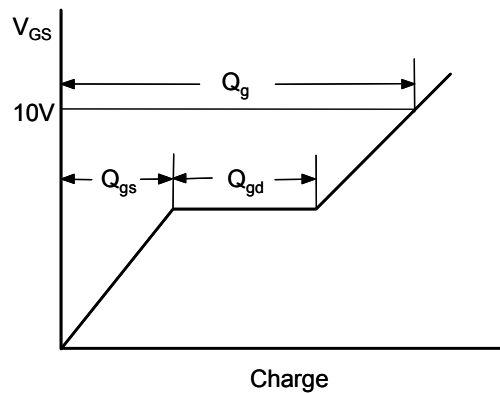
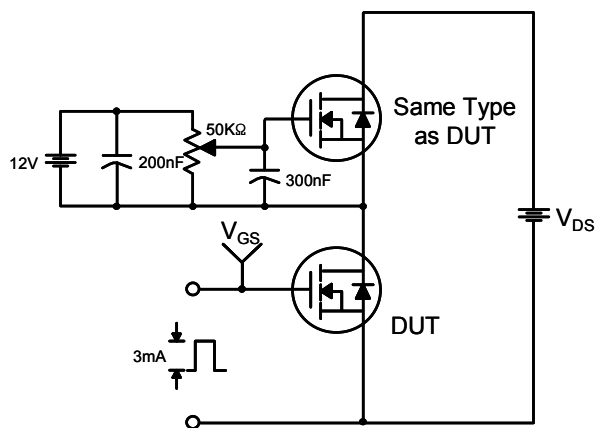
## Figure 11-1. Transient Thermal Response Curve for FQP11N50CF



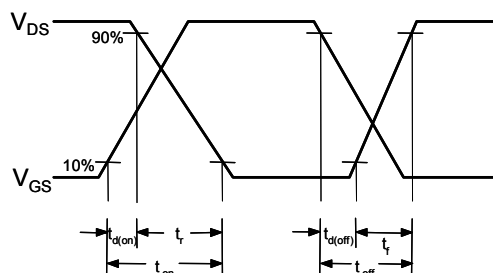
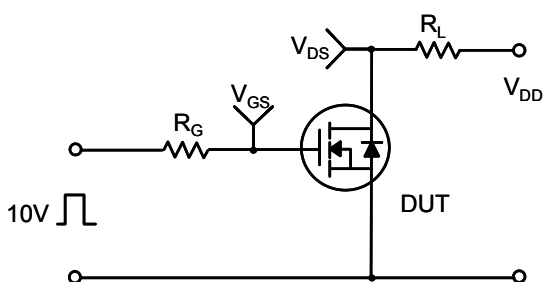
## Figure 11-2. Transient Thermal Response Curve for FQPF11N50CF



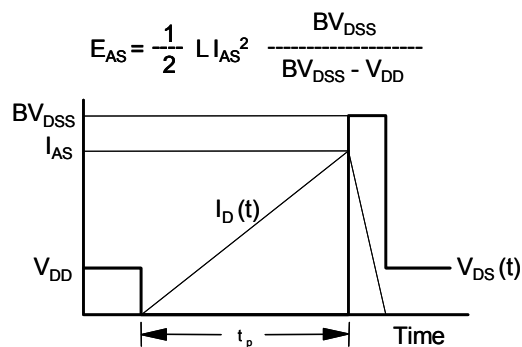
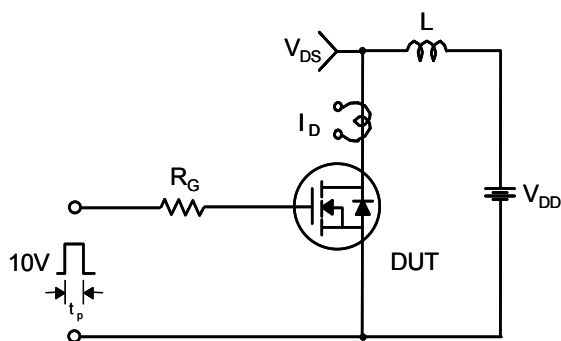
### Gate Charge Test Circuit & Waveform



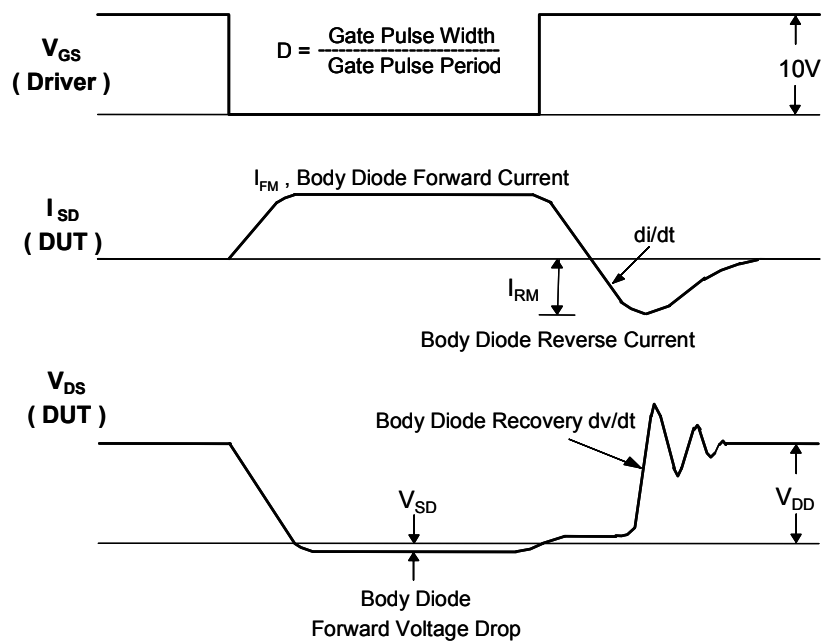
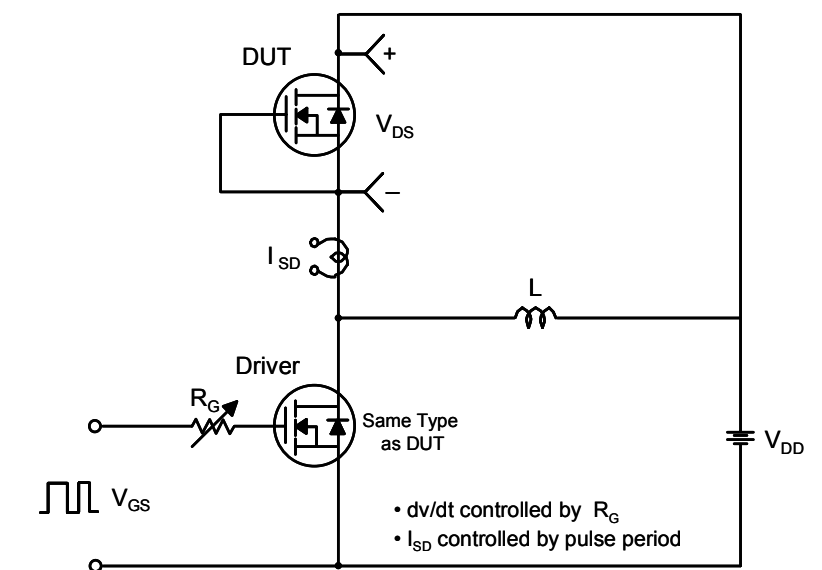
### Resistive Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms

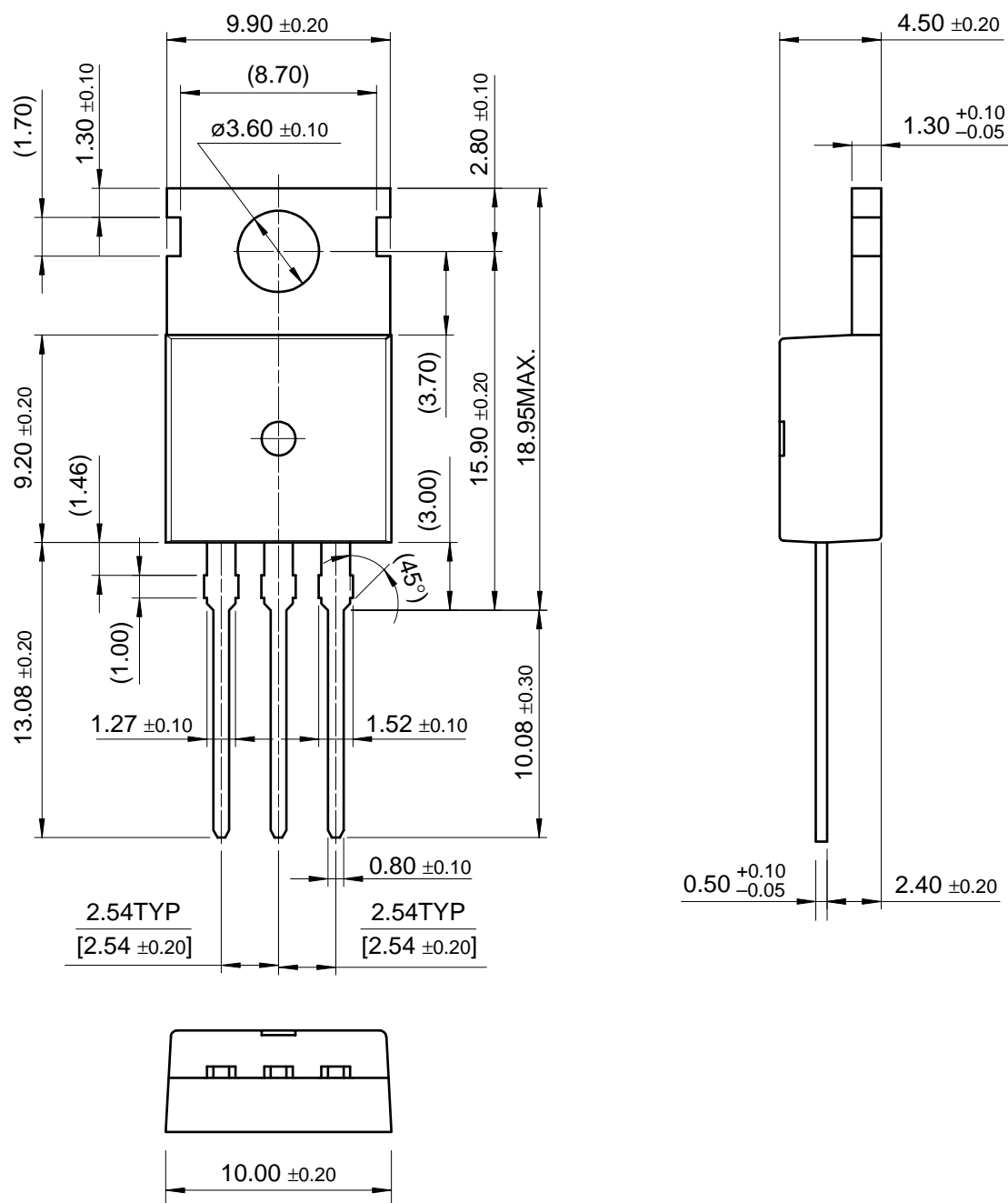


# Peak Diode Recovery dv/dt Test Circuit & Waveforms



## Mechanical Dimensions

# TO-220

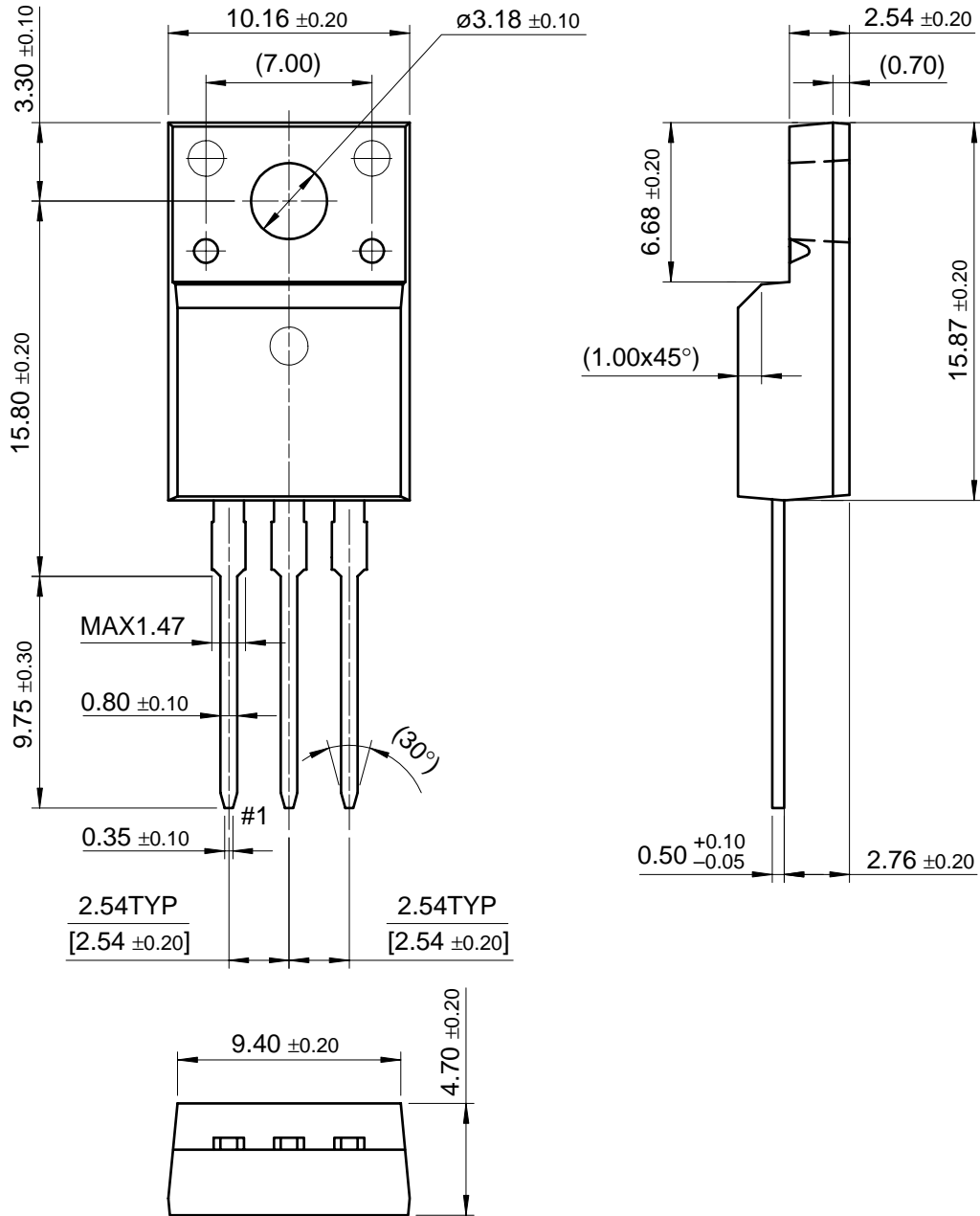


### Dimensions in Millimeters



**Mechanical Dimensions** (Continued)

**TO-220F**



Dimensions in Millimeters

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